REPORT DOCUMENTATION PAGE

Form Approved
OPM No. 0704-0188

AD-A230 494

PORT DATE	3. REPORT TYPE AND DATES COVERED
GUST 1988	DRAFT

4. TITLE AND SUBTITLE

MANPRINT Analysis Methodology: Victory Through Design

5. FUNDING NUMBERS

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

PATH Training Corp./ HQDA MANPRINT Directorate
Frederick, MD The Pentagon

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Headquarters, Department of the Army
The Directorate for MANPRINT Research and Studies
Room 2C733, The Pentagon
Washington, D. C. 20310-0300

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for Public Release: Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

MANPRINT is an Army program developed to optimize the human dimensions of systems design through early involvement in systems design/systems engineering. The MANPRINT Analysis Methodology was created to provide the initial quantitative structure for the MANPRINT community to participate in the systems design/systems engineering processes by providing a quantitative structure for human-dimension influence in system design processes. The document focuses on the integration of human dimensions within two cardinal analyses: The Cost and Operational Effectiveness Analysis and the Reliability, Availability, Maintainability Rationale Report.

14. SUBJECT TERMS
MANPRINT, Combat Modeling, Systems Design, COEA, Combat Developments, RAM, Design Influence, Systems Engineering

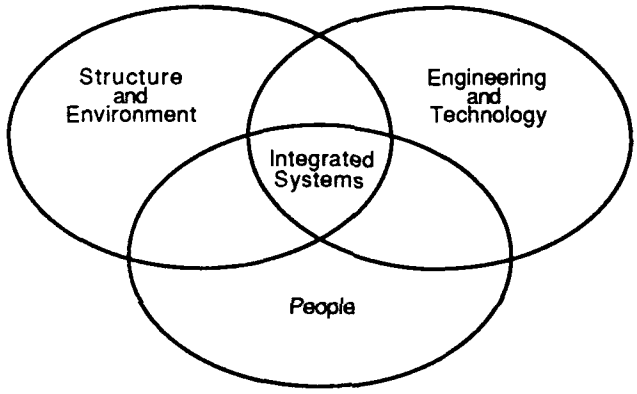
15. NUMBER OF PAGES
66

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	**UNCLASSIFIED**	**UNCLASSIFIED**	

DRAFT

MANPRINT Analysis Methodology



Victory Through Design

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VHG 12/04/90

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1.0 INTRODUCTION

1.1 General

MANPRINT refers to the comprehensive management and technical effort to assure total system effectiveness by constructive integration into material development and acquisition all relevant information concerning the MANPRINT domains of Manpower, Personnel, Training, Human Factors Engineering, System Safety, and Health Hazard Assessment. Although the MANPRINT process has attained many of its objectives in recent materiel procurements, there remains insufficient integration of MANPRINT factors into key materiel acquisition process (MAP) events, studies, and analyses including:

- Operational Mode Summary/Mission Profile (OMS/MP)
- Operational and Organizational Plan (O&O Plan)
- Reliability, Availability, and Maintainability (RAM)
- Cost and Operational Effectiveness Plan (COEA)
- Required Operational Capability (ROC)
- Request for Proposal (RFP)
- Testing and Evaluation (T&E)
- Fielding.

These materiel acquisition process events are critical to the determination of system performance and cost requirements and to ensuring that system performance and cost objectives are met throughout the materiel acquisition process. Therefore, it is essential that MANPRINT factors are fully integrated into these materiel acquisition process events.

There are several root causes for the insufficiency of integration of MANPRINT factors or data into the materiel acquisition process activities identified above. These include the following:

1. There are inadequate guidelines for integrating MANPRINT analysis techniques and data into the methods and products of the materiel acquisition process activities

2. There is a lack of analytical techniques for developing early quantitative and qualitative manpower, personnel, and training (MPT) data to be used in RAM and COEA functions

3. Many MANPRINT analytical techniques (e.g., Hardware versus Manpower Comparability Analysis (HARDMAN) and Early Comparability Analysis (ECA)) are labor, data, and expertise intensive; thus, cost effective implementation generally is limited to major procurements, and there are few "streamlined" techniques for minor procurements.

4. materiel acquisition process cost and performance data does not always dovetail with MANPRINT data because different Baseline Comparison Systems (BCS) are used as the bases for analysis

5. There is a lack of guidance for selecting MANPRINT analytical techniques to match materiel acquisition process events and user representative needs

6. There is a lack of guidance on how to translate MANPRINT quantitative data into materiel acquisition process performance and cost objectives that can be tested and evaluated throughout the system life cycle

1.2 Purpose

The purpose of this handbook is to provide guidance for the selection and implementation of MANPRINT analytical techniques used to develop MANPRINT data necessary to the development of organization and doctrine; materiel requirements; research, development, test & evaluation of materiel; management of personnel resources; training and development of personnel; system safety assessment; integrated logistics support; and system reliability, availability, and maintainability.

The handbook has been developed to provide support to user representatives in order to avoid, or mitigate, the problem of integration of MANPRINT analyses and data into key materiel acquisition process events. To attain this objective, the handbook sets forth guidelines, analysis techniques, and general information that will help the user representative more effectively integrate MANPRINT data and analysis techniques into key materiel acquisition process events.

1.3 Scope

The handbook does not purport to address every MAP-MANPRINT interface. It is designed to provide guidance for integrating MANPRINT with the selected key materiel acquisition process events. Figure 1-1 presents the key MAP-MANPRINT interfaces which are addressed in this handbook and illustrates the flow in the materiel acquisition process.

Figure 1.1 illustrates, also, the primary influence of materiel acquisition activities (i.e., technology influence or design influence). As can be seen in the figure, the early materiel acquisition process-MANPRINT activities, including OMS/MP, O&O Plan, RAM, COEA, and CFP, primarily influence system technology issues. These issues include the identification of functional requirements, function allocation between man and machine, the general specification of hardware/software requirements, and the initial identification of subsystems and candidate equipment. The materiel acquisition process and MANPRINT activities associated with ROC substantially influence the design of the proposed system. MANPRINT data, by this time, includes specific requirements and constraints from each MANPRINT domain that must be met in system design. The RFP is the vehicle by which all system requirements are translated into contract specifications and subsequent detailed system design by contractors.

Figure 1.1 also identifies key materiel acquisition process-MANPRINT interfaces in the areas of T&E and Fielding. The MANPRINT activities associated with T&E and Fielding primarily involve the validation of system performance and influence system supportability.

In summary, the events depicted in Figure 1.1 are (1) those that are critical to the development of the system performance and cost data on which technology, design, and supportability decisions are based and (2) those where it is most critical to get personnel/human resources inputs if MANPRINT objectives are to be attained during the materiel acquisition process and fielding of the system (Figure C-1, which is located in Appendix C, provides a more detailed version of the materiel acquisition process and interfaces with MANPRINT and identifies MANPRINT analytical techniques which are generally appropriate for each phase of the system life cycle).

This handbook is not intended to be self-sufficient in terms of discussing MANPRINT analytical techniques. It makes reference to other

MANPRINT documents that provide the detailed guidance and procedures for implementing many of the MANPRINT analytical techniques.

This handbook is divided into this introductory section and eight technical sections that address the MANPRINT interfaces. Section 2.0 addresses the OMS/MP-MANPRINT interface. This interface is different from the other seven MAP-MANPRINT interfaces in that the OMS/MP provides data that is the basis for MANPRINT analyses. The other MAP-MANPRINT interfaces that are covered in this document are characterized, primarily, by the materiel acquisition process activity being supported by MANPRINT inputs and analyses in order to ensure that the output of the materiel acquisition process activity incorporates MANPRINT concerns and data.

Each of the last technical sections provides the following information:

o Overview -	Describes the MAP-MANPRINT interface and discusses why MANPRINT interface is important.
o Data Requirements -	Describes the required MANPRINT data and how it is used in the materiel acquisition process activity or document.
o Responsibility -	Identifies who is responsible for development of MANPRINT data.
o When -	Defines when each type of data is required and how it is to be coordinated with materiel acquisition process activities.
o Analytical Techniques -	Identifies analytical techniques and discusses applicability to system and MAP-MANPRINT interface.
	Discusses assumptions underlying each technique, limitations and constraints, input requirements, and outputs. Provides decision table for

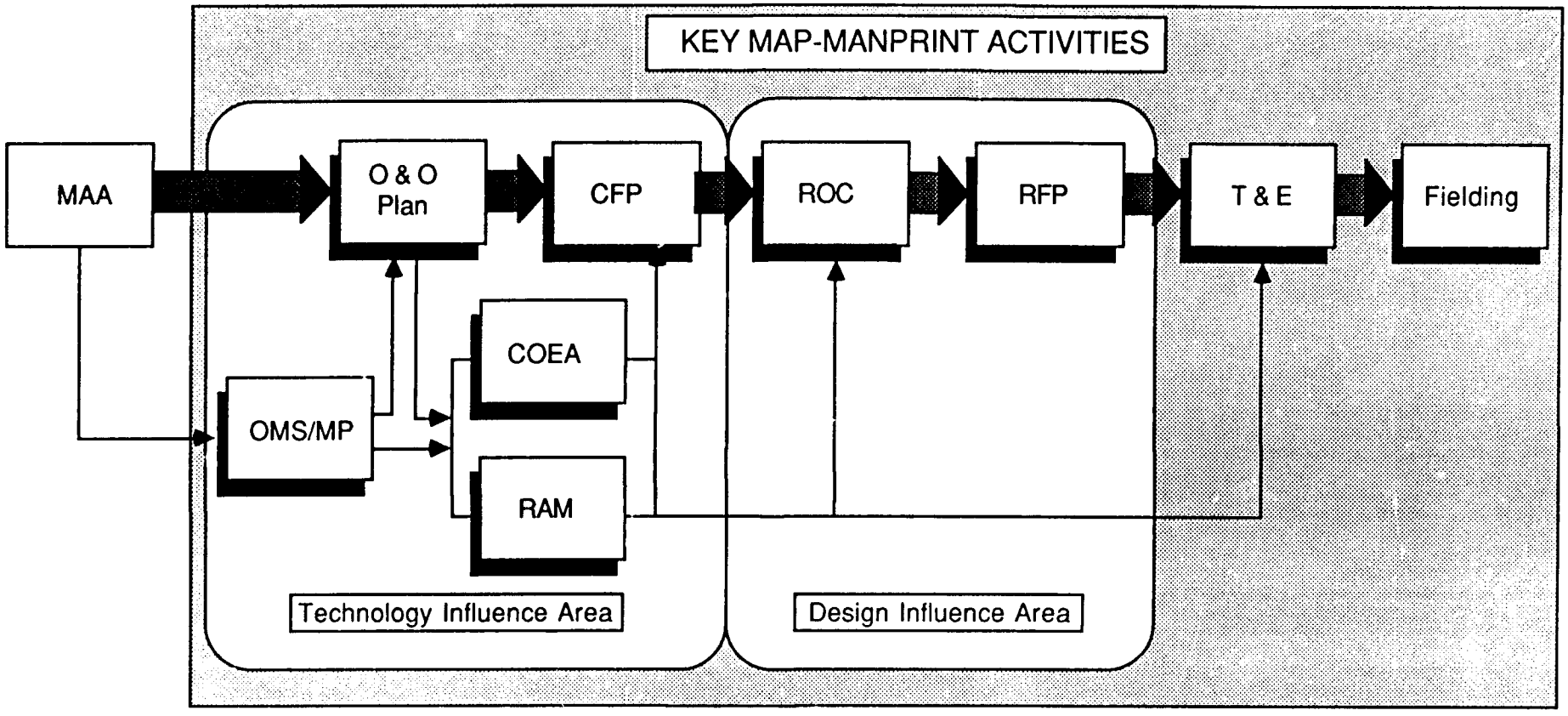


Figure 1-1. Materiel Aquisition Process (MAP)/ MANPRINT Analysis Interface

selecting appropriate technique, if applicable.

- Integration - Discusses critical relationships between MANPRINT analytical techniques, uses of data generated, integration of analyses and data within MANPRINT domains, and integration of MANPRINT with other materiel acquisition process events/documents.

- Checklist Questions - Contains a series of checklist questions covering the objectives of the interface, the selection of analytical techniques, and the implementation of the analysis.

- Traps - Lists most common errors made in selection and implementation of analyses and development of data.

- References

Each of the last seven technical sections is accompanied by a "Toolkit" contained in an appendix. The Toolkit specifies in detail the interface requirements and provides procedures for meeting the requirements. Appendices containing a glossary of terms and a list of acronyms are attached also.

2.0 OMS/MP-MANPRINT INTERFACE

2.1 Overview

The Operational Mode Summary/Mission Profile (OMS/MP) describes how a system will be used. The OMS is a description of the anticipated ways the equipment will be used in carrying out its operational role. It includes expected percentage of use in each role and percentage of time it will be exposed to each type of environmental conditions during the system's life. The mission profile is a time phased description of the operational events and environments an item experiences from beginning to end of a specific mission.

The OMS/MP must be the source document on usage rates on all studies that support the system. OMS/MP also provides the basis for initial MANPRINT analyses.

2.2 Data Requirements

In order for MANPRINT analyses to be conducted in a timely fashion, the OMS/MP should contain the following operational data:

1. Mission profile quantitatively described in terms such as hours, miles, and rounds.

2. Wartime and peacetime mission profiles.

3. Expected percentage of use and/or event duration and frequency for each mission profile.

4. Expected mix of movement terrain (if applicable).

5. Deployment of the fleet in the climatic conditions described in AR 70-38.

6. Average usage (e.g., hours, miles, rounds) for the period of time considered.

7. Operating and alert times for each mission profile (when appropriate)

8. Mission task lists with appropriate frequency and quantitative performance data (e.g., hours, miles, rounds).

9. Assumptions which underly the OMS/MP.

In addition the OMS/MP should contain data regarding subsystem requirements and predecessor or reference systems. This data is important in that it establishes the baseline for comparison studies. The data should include (1) a brief system description and identification of anticipated subsystem requirements, (2) predecessor or reference system/subsystems for each subsystem, and (3) a mission requirement comparison. The mission requirements comparison should briefly state (1) any major changes in quantitative mission requirements and (2) any known problems with predecessor equipment that had impaired mission performance or limited mission goals.

For example, this data might appear as follows:

EXAMPLE SYSTEM DESCRIPTION

System Description - The proposed ABC system will be a track mounted ground-to-air missle system. The major subsystems will be the carrier, fire control system, missle launcher, and communcations unit. Predecessor systems/subsystems include the M-45 tank, Hawk, Chapparal, and Precision Night Vision system.

Total Army Requirements

Active	ARNG	USAR
1920	125	140

Subsystem Description

Subsystem	Predecessor System	Mission Requirements Comparison
TV Camera	Chapparal/ Hawk	No technology improvements required
Electro-Optical Pack	Hawk/Chapparal/ Precision Night Vision System	Current system inadequate for proposed tareget ranges. Design advances should ensure no increase in repair skill requirements.
Azimuth/ Elevation Drive	Hawk	Will require approximately 40% increase in operating capability to meet Firing requirements. Previous system was a low maintenance manpower driver. Anticipate a sligh increase in maintenance manpower requirements. with no increase in maintenance skill requirements.

EXAMPLE SYSTEM DESCRIPTION (continued)

Subsystem Description

Subsystem	Predecessor System	Mission Requirements Comparison
Electronic Counter-Measures Module	Hawk	Predecessor system marginally adequate to meet anticipated threat. Consideration should be given to incorporating advanced ECCM in M-1 Tank which has high reliability.
Acquisition Sensor	Hawk/ Chapparal	Predecesspr system not capable of meeting target(s) range and density requirements. New technology anticipated.
Missile/ Launcher	Hawk	No technology improvements required.
LASER	Hawk	Current Lithium Arsenide Laser not capable of meeting mission requirements related to target range and rate of fire. New technology anticipated. Laser must meet new levels of reliability to reduce maintenance/repair actions. Presently fielded Laser is a top maintenance manpower driver.
FLIR	Hawk	Presently fielded FLIR has good reliability but is a top maintenance manpower driver due to lengthy repair times. Improper repair has contributed to operational mode failure. Repair problems associated with hermetically sealed design and requirement for special tools and repair skills.
Fire Control Electronics	Hawk	Current Fire Control Electronics system capable of meeting mission requirements, but has been a top maintenance manpower driver. Maintenance/repair design needs to be improved in arease of accessibility to higher failure rate components in cabinets, number of replacement modules, and use of special tools. Improvements in layout should increase reliability of operator performance. Anticipate modified NDI acquisition.
Power Supply	Hawk	No improvements required.
Carrier	Hawk	There are no required technology enhancements for the carrier vehicle. Current system is a top maintenance manpower driver. Improvements in accessibility of higher failure rate components and increase in electrical replacement modules will reduce maintenance manhour requirements.

The operational and system data described provides an adequate base from which to develop precise MANPRINT concerns, define the MANPRINT analysis program, and conduct initial MANPRINT analyses in order to generate the MANPRINT data that feeds into early materiel acquisition process activities such as COEA, RAM, and ROC.

Note: There is no Toolkit for the OMS/MP-MANPRINT interface.

3.0 O&O Plan-MANPRINT INTERFACE

3.1 Overview

The O&O Plan is the program initiation document for those programs requiring a JMSNS, JSOR, or ROC. It is prepared by the combat developer, in coordination with the materiel developer, training developer, transportability agent, logistician, MANPRINT planner, tester, evaluator, and interested MACOM.

The O&O Plan will outline, in as much detail as possible, how a materiel system will be used, how it will be supported, how it will ultimately contribute to combat capability, what materiel interface is required, in what organization(s) it will be placed, and if applicable, the system(s) to be replaced. It will provide the basis for initial definition of test and evaluation requirements (to include issues and criteria) and activities.

The O&O Plan represents the start of the continuous process of feeding MANPRINT data into the materiel acquisition process. At this point in the materiel acquisition process, and to meet the O&O Plan requirements, MANPRINT data will be gross in nature and focus on defining general technology problem areas rather than being highly specific and quantitative and focused on particular design, environmental, and performance issues.

3.2 Data Requirements

The MANPRINT data requirements for the O&O Plan are spelled out in the System MANPRINT Management Plan (SMMP) and include the following:

1. Initial MANPRINT objectives, which may translate into constraints in the O&O Plan. An objective(s) should be established for each domain.

2. Key concerns in each MANPRINT domain. These are issues to be watched and addressed via MANPRINT analytical techniques.

3. Unresolved questions. These are questions related to concerns that should be answered via MANPRINT Analyses, and when answered, the concerns are rectified.

The MANPRINT objectives, concerns, and unresolved questions are to be developed on the basis of (1) an evaluation of the OMS/MP operational data, (2) an evaluation of the OMS/MP system description, and (3) the results of initial MANPRINT analyses (if completed in time to meet the O&O Plan schedule). Within each MANPRINT domain they should achieve the following:

(1) Establish general performance goals, constraints, and limitations.
(2) Identify potential problem areas or concerns.
(3) Provide guidance for planning the MANPRINT analysis program.
(4) Establish general guidelines and a framework for the MANPRINT T&E program.

The MANPRINT data will be an annex to the O&O Plan and is to be presented in a format consistent with other O&O Plan annexes.

3.3 Responsibility

It is the responsibility of the combat developer to develop the O&O Plan-MANPRINT interface data. This is normally accomplished by establishing a MANPRINT Joint Working Group (MJWG) and assigning the MJWG the task of developing the initial SMMP, which includes developing the MANPRINT inputs to the O&O Plan.

3.4 When

MANPRINT data is needed prior to the scheduled date for the first draft of the O&O Plan. It will be reviewed and revised in accordance with the O&O Plan review cycle. Development of MANPRINT data should begin as soon as the OMS/MP is available.

3.5 Analytical Techniques

MANPRINT analytical techniques applicable to the development of system MANPRINT objectives, concerns, and unresolved questions include (1) MANPRINT Concern Identification and (2) MANPRINT Risk Assessment. Guidelines for implementing these techniques are contained in the O&O Plan-MANPRINT Toolkit in Appendix D.

3.6 Integration

MPT concerns are likely to be clearly related to HFE concerns. In particular, resolution of HFE problems (both operational and maintenance related problems) can significantly effect quantitative and qualitative personnel concerns. Once objectives, concerns, and unresolved questions have been established for each domain, they should be reviewed within the context of the total MANPRINT picture to ensure that there are no inconsistencies.

3.7 Checklist Questions

- To the degree possible, are objectives stated in quantitative terms?
- Do objectives reflect known problems with predecessor/reference systems?
- Are objectives consistent among all MANPRINT domains?
- Are assumptions stated for each concern?
- Are concerns stated in system specific terms, i.e., tailored to a specific operational and equipment problem area?
- Is each concern focused on a particular problem area rather than combining multiple problems under one statement of concern?
- Do concerns reflect the interrelationships between MANPRINT domains?
- Are unresolved questions developed for all areas of concern?
- Do unresolved questions provide guidance for determining analytical techniques to be used in MANPRINT analyses?
- Do unresolved questions identify critical test and evaluation issues?

3.8 Traps

- Objectives, concerns, and questions are stated in such general terms (or worse -- boilerplated) so that they do not achieve their purposes of (1) defining constraints and limitations in the O&O Plan, (2) providing guidelines for determining analytical techniques, and (3) establishing issues for system test and evaluation.

- MANPRINT data could be based on specifications different from those being used as the bases of other parts of the O&O Plan. For instance, different OMS/MP requirements (if an OMS/MP update has been conducted) could be used.

- Seemingly trivial concerns may be overlooked or not included.

- All assumptions associated with a concern are not stated.

3.9 References

- System MANPRINT Management Plan (SMMP) Procedural Guide

- SSC-NCR MANPRINT Risk Assessment

- AR 71-9 Materiel Objectives and Requirements

4.0 RAM-MANPRINT INTERFACE

4.1 Overview

Reliability, availability, and maintainability (RAM) requirements are those imposed on materiel systems to ensure they are operationally ready for use when needed, will successfully perform assigned functions, and can be economically operated and maintained within the scope of logistic concepts and policies. RAM programs are applicable to materiel systems, test measurements and diagnostic equipment (TMDE), training devices, and facilities developed, produced maintained, procured, or modified for Army use. Reliability is the duration of probability of failure free performance under stated conditions. Availability is a measure of the degree to which an item is in operable or committable state at the start of the mission. Maintainability is the availability of an item to be retained in or restored to specified condition within a given time when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level or maintenance and repair.

The RAM community has developed an impressive array of definitions and mathematical models for the analysis and prediction of materiel readiness, based on the widely accepted concept equipment operational availability (A_0). Generally, RAM models have not addressed the issue of human reliability performance within the framework of the soldier/system/mission interface, or at best, it is buried in the A_0 measurements of Mean Time Between Operational Mode Failure (MTBOMF), Mean Time Between Unscheduled Maintenance Action (MTBUMA), Mean Time to Repair (MTTR), or Administrative and Logistics Downtime (ALDT).

The RAM related objectives of MANPRINT are to:

(1) develop human reliability estimates for personnel associated with operations, maintenance, and administrative and logistics actions, and

(2) integrate human reliability estimates with the A_0 concept so that a more precise prediction and evaluation of system readiness can be obtained.

(3) establish failure definitions and scoring criteria, up front, to be used as the guidelines to clarify the cause and effect of human error contributions to the test incidents. The outcome of the scoring of human performance during testing will be used to determine the human reliability estimates for the system at that point in time.

Without human reliability factors and data, technical design of systems may result in excessively expensive systems or systems that do not fulfill mission requirements because of mismatches between the soldier and the system. Further, test and evaluation studies may result in identifying and connecting symptoms rather than the actual reliability problems.

More specifically to the RAM-MANPRINT interface, human reliability data provides the RAM analyst with information that is critical to the establishment of A_0 prediction and to the prediction of mission success. MANPRINT human reliability estimates are made for operations and maintenance functions and are directly related to the following RAM concerns:

o	MTBOMF	Mean Time Between Operational Mode Failure
o	MTBUMA	Mean Time Between Unscheduled Maintenance Action
o	MTTR	Mean Time To Repair
o	ALDT	Administrative and Logistic Downtime

Human reliability analyses are conducted in order to (1) establish requirements for human reliability and RAM, (2) establish human reliability personnel performance test and evaluation criteria, and (3) define and evaluate system tradeoffs.

Human reliability data, similarly to the materiel/RAM data, is initially more gross in nature and presented in bands during the early materiel acquisition process phases. As system specifications harden and more detail is known about personnel performance requirements, the human reliability data becomes more focused and precise.

Human reliability data is related to RAM data in other ways. First, it is employed both as a measure of performance and as a performance

requirement. Second, as RAM indices may be improved through a variety of techniques such as redundancy, component selection, provisioning, and maintenance philosophy, human reliability may also be improved. The most common methods for improving human reliability are personnel selection, human engineering, function allocation, training, and improved job performance aids Human reliability is dependent, however, on not only what may be considered other MANPRINT concerns but also on engineering and mission factors such as system design, maintenance philosophy, and mission characteristics.

The critical point is that the soldier's performance is one of the most important elements in mission achievement and A_0 equations. To ensure that it is considered, it must be quantified and presented in a useful format.

It should be noted that human reliability has not been generated or utilized within the materiel acquisition process prior to the establishment of the MANPRINT program. The primary reason for this has been a lack of analytical tools to develop the human reliability estimates.

The purpose of this section of the handbook first is to define the human reliability requirements and their usage by RAM analysts and to present analytical techniques for developing human reliability estimates. RAM requirements and measurements are the heart of materiel readiness Human reliability requirements and measurements are the heart of personnel readiness and must be pursued as assiduously as those of RAM if systems are to be operationally ready for use when needed.

4.2 Data Requirements

The MANPRINT data to be utilized in RAM analyses are comprised of estimates of human reliability associated with major operations and maintenance functions and failure definition/scoring criteria. The human reliability estimates are presented as a probability ranging from 0.00 to 1.00 or as a probability band.

As stated earlier, human reliability data is closely related to RAM data and is generated within the same general framework. The key question that the data answers is what is the contribution of soldier performance to:

- o MTBOMF
- o MTBUMA
- o MTTR
- o ALDT

The data requirements associated with each of these is discussed in the following subsections. Also addressed in the following subsections is the establishment of failure definitions and scoring criteria.

4.2.1 HR-MTBOMF Data

MTBOMF is a measure of operational effectiveness that considers the inability to perform one or more mission essential functions (MEF). HR-MTBOMF is a measure of the contribution of personnel performance to failure to accomplish mission objectives or MEFs.

Human reliability estimates for MTBOMF should be developed for missions, mission tasks, and job functions and tasks. Most frequently in the early stages of an acquisition, it is possible only to develop gross estimates, or probability bands, of human reliability by mission and mission tasks as specified in the OMS/MP, because there is not enough information on specific job functions and tasks. For example, a FLOT defense Mission for a track mounted ground-to-air missile system, mission tasks will include (1) movement, (2) set-up and pre-op checks, (3) search and surveillance, (4) target acquisition, (5) tracking, (6) fire, and (7) tear down. An estimate of the probability that crew personnel will successfully complete the mission tasks (i.e., there will be no operational mode failure due to personnel error) should be provided for each task.

During the latter stages of the materiel acquisition process, and if the acquisition is of size and complexity to warrant it, the more detailed human reliability estimates for operator performance may be developed by job function and task.

4.2.2 HR-MTBUMA Data

MTBUMA is a measure of materiel readiness that considers equipment and component failure rates and associated requirements for unscheduled maintenance. HR-MTBUMA is a measure of the contribution of personnel (i.e., crew) performance to system, equipment, and component failure.

HR-MTBUMA estimates should be developed for the system, subsystems, equipment, and major components. HR-MTBUMA estimates developed during the early stages of the materiel acquisition process commonly are probability bands for human reliability associated with the major subsystems identified in the OMS/MP. It is not possible to develop detailed human reliability estimates for equipment and major components because of the lack of detailed hardware/software specifications and function allocation.

During the latter stages of the materiel acquisition process, and if the system is of size and complexity to warrant it, the more detailed estimates for HR-MTBUMA may be developed by equipment/component and job function and task.

4.2.3 HR-MTTR

MTTR is the sum of corrective maintenance times divided by the total number of corrective maintenance actions during a given period under stated conditions. As such, MTTR includes personnel performance in the establishment of MTTR as well as considering the maintenance task and the environment. HR-MTTR is the measure of the contribution of personnel performance to MTTR. It is important to establish HR-MTTR in order to:

- Develop MTTR requirements
- Establish MTTR test and evaluation criteria regarding personnel performance
- Define and evaluate system tradeoffs

HR-MTTR estimates should be developed for subsystems and major equipment and components. Like other human reliability estimates, HR-MTTR can only be developed in broad terms (i.e., probability bands) and for the anticipated hardware/software configuration--usually subsystems--

identified in the OMS/MP early in the materiel acquisition process. More detailed analyses are possible when the system and associated maintenance requirements are better defined.

4.2.4 HR-ALDT

ALDT is the administrative and logistics downtime spent waiting for parts, maintenance, personnel, or transportation. Since nonoperational mission failure usually causes downtime only during active, corrective, or preventative maintenance, ALDT is incurred and calculated only for operational mission failures. ALDT is usually the single factor that contributes the most to the total downtime of a system. Because of this, the most realistic estimates of ALDT must be developed to ensure that the final RAM requirements meet the user's requirements. An underestimation of ALDT will cause the RAM requirements to be stated too low, and vice versa.

HR-ALDT is the more specific estimate of the contribution of personnel and performance to ALDT. Human reliability-ALDT values should be established for each support alternative if more than one is being considered. The results of the HR-ALDT are used as an aid in selecting and evaluating MPT alternatives as they relate to ALDT functions.

4.2.5 Failure Definition and Scoring Criteria

Paragraph three of the RAM Rationale Report presents the Failure Definition/Scoring Criteria (FD/SC) applicable to a given system. The FD/SC serve to characterize the performance of the equipment to be tested and thereby to establish an agreed upon database for making reliability and maintainability assessments after the testing is completed.

RAM FD/SC consists of two sections:

- Mission essential functions
- Classification/chargeability guidelines.

Human Reliability FD/SC should be established for each mission essential function (i.e., establish the critical human performance functions, in quantitative terms, required to achieve the system's mission essential functions). These are the failure definitions and are framework for (1) initial human reliability estimates, and (2) the human performance T&E

program and subsequent human reliability assessments.

Classification/chargeability guidelines, or scoring criteria, are established for each defined failure (although most failure definitions will have common classification/chargeability guidelines). The critical issue is to have a systematic approach for (1) clarifying a test and (2) charging a test failure to specific cause.

4.3 Responsibility

It is the responsibility of the RAM analyst to develop the RAM-MANPRINT interface data which consists of the human reliability estimates associated with MTBOMF, MTBUMA, MTTR, and ALDT. The RAM analyst will supply the human reliability estimates to the combat developer for integration into the development of other MAP-MANPRINT analytical techniques.

4.4 When

Human reliability data associated with MTBOMF, MTBUMA, and MTTR will be developed concurrently and integrated with initial RAM processes. Human reliability data associated with ALDT will be developed after the support alternatives have been defined and concurrently with the development of ALDT estimates.

Human reliability data updates and refinements will be conducted concurrently with any RAM data updates.

4.5 Analytical Techniques

As noted earlier, the primary reason that human reliability data has not been integrated into the materiel acquisition process, including RAM, is the lack of methods available for determining human reliability values. MANPRINT analytical techniques applicable to the development of human reliability estimates include (1) the Simplified Technique for Estimating Human Reliability (STEHR), and (2) human reliability Simulation Models. Human reliability Simulation Models are currently under development by the Army Research Institute (ARI). Therefore, the only available method for developing human reliability estimates at this time is STEHR. Guidelines for implementing this technique are contained in the RAM-MANPRINT Toolkit in Appendix E. The Toolkit also provides guidelines

for developing failure definitions and scoring criteria and for conducting tradeoff studies between human reliability, personnel factors, and human factors engineering.

4.6 Integration

The human reliability data that is developed to support the RAM-MANPRINT interface is like a silver thread that runs through all MANPRINT processes and analyses and impacts on all other domains -- either as a requirement or a measure of performance. It is particularly critical during the RAM-MANPRINT interface that the interdependencies between human reliability and the other domain issues be identified and stated. As appropriate, tradeoff studies between human reliability, personnel qualifications, and human factors engineering should be conducted.

4.7 Checklist Questions

- Are all assumptions and conditions associated with each human reliability value clearly defined and stated?
- Are relationships between human reliability and other MANPRINT data clearly defined and assessed?
- Is the analysis based on the latest OMS/MP?
- In evaluating human reliability, has consideration been given to the possibility of quantum improvements that may be attained through design changes, technology insertions, modifications in function allocation, or maintenance philosophy, etc.
- Does the HR-FD/SC enable consistent classification of test incidents in relation to the RAM FD/SC?
- Does the HR-FD/SC properly call for the data needed to estimate the human reliability parameters?
- Has the HR-FD/SC been coordinated with the RAM analyst and T&E specialist?

4.8 Traps

- Starting analyses without reasonably firm OMS/MP data or mission essential functions.

- Exercise caution when using personnel performance data from predecessor system acquisitions and evaluations as it (1) may not apply or (2) may have been collected under unacceptable conditions.

- If using subject experts to estimate/define personnel performance requirements, ensure that an adequate sample of experts is used.

- The use of 'partial failure' concept.

- The use of a generic FD/SC that has not been tailored to match the characteristics and requirements of the system.

4.9 References

- AR 702-3 Army Materiel Systems Reliability, Availability, and Maintainability

- TRADOC/AMC PAMPHLET 70-11 RAM Rationale Report Handbook

5.0 COEA-MANPRINT INTERFACE

5.1 Overview

A cost and operational effectiveness analysis (COEA) is a documented investigation of the comparative effectiveness of alternative means of meeting a requirement by eliminating or reducing a force or mission deficiency against a defined threat, and the cost of developing, producing, distributing, and sustaining each alternative system in a military environment. A COEA will be prepared by the combat developer for each DAP and DOD major program. An Abbreviated Analysis will be prepared for all other programs. For these programs, a COEA or Abbreviated Analysis is required at milestone decision review-I for all programs. As a rule, the milestone decision review-I supporting analysis will be updated as subsequent changes have occurred in the mission, threat, technology, or alternatives.

Key cost categories for the COEA or Abbreviated Analysis are system acquisition costs (including cost of all life cycle functions), force costs, and training. Accurate MANPRINT data are required, particularly MPT data, if the COEA or Abbreviated Analysis is to yield a sound cost basis for decision making.

MANPRINT data are required also if the operational effectiveness of a system is to be accurately projected and evaluated. Basically, the key issue is to determine the impact of human performance and reliability on the ability of the system to perform its mission. The impact of human performance and reliability must be quantified and presented in a numeric form if it is to be useful in the COEA.

COEAs are performed or updated throughout the materiel acquisition process and are classified as follows:

Type I COEA - Supports milestone decision review-I Defense Acquisition Board and materiel documentation (ROC, O&O Plan). Consists of preliminary appraisal. Both performance expectations and costs are presented usually as bands with reliance on "top down" estimating techniques.

Type II COEA - A detailed comparative evaluation of development alternatives that supports milestone decision review-II Defense Acquisition Board. Performance and cost bands can be focussed down to point estimates. COEA include life cycle costs of all alternatives, total comparative costs of the alternatives, and force costs associated with alternatives.

Type III COEA - Consists of an update of Type II COEA and performed by exception only as needed to support milestone decision review-III Defense Acquisition Board.

5.2 Data Requirements

MANPRINT data to be provided as an input to COEA or Abbreviated Analysis for each MANPRINT domain are described in the following subsections.

5.2.1 Manpower Data Requirements

The critical manpower data are MOS requirements including number and grade of personnel required for each MOS for each system. This data should be listed for operations and maintenance (not including depot maintenance). This quantitative personnel data provides the basis for developing direct and indirect personnel costs and for estimating impact on force structure.

5.2.2 Personnel Data Requirements

Qualitative personnel data required for the COEA include:

(1) a description of the aptitude requirements by MOS and Grade
(2) a statement of the impact of the manpower and personnel requirements on force structure
(3) estimates of operator or human reliability associated with MTBOMF and MTBUMA (see Section 4.0)
(4) estimates of maintenance personnel reliability for each major subsystem expressed in human reliability impact on MTTR and ALDT (see Section 4.0)

(5) identification of any other system or mission characteristics that drive or constrain manpower and personnel requirements.

Qualitative personnel data is used to assess operational effectiveness, provide additional detail to the manpower cost base, and identify areas where changes could result in a more favorable COEA result.

5.2.3 Training Data Requirements

Training information to be provided for the COEA includes the following:

- Number of training days of formal system specific operations and maintenance training for each MOS. It will include advanced individual training (AIT) and unit training estimates, but will not include any ARTEP, readiness experience activity, or field training exercises.

- Identification of special training devices, special training media, or high cost training strategies.

5.2.4 Human Factors Engineering (HFE) Data Requirements

HFE data required is a qualitative estimate of problems that could arise from personnel-system interfaces and identification of HFE improvement areas. This data should be consistent with the HFE objectives and concerns stated in the O&O Plan. HFE data is used in system definition, design, development, and evaluation in order to optimize the capabilities and performance of man-machine combinations. HFE data, generally, includes the following:

- Human characteristics
- Anthropometric data
- System interface requirements
- Human performance
- Biomedical factors

5.2.5 System Safety (SS) Data Requirements

System safety data should include the SS concerns identified in the O&O Plan and any results from safety assessments that could impact system performance or cost.

5.2.6. Health Hazards (HH) Data Requirements

Health Hazards data should include the HH concerns identified in the O&O Plan and any results from health hazards assessments that could impact system performance or cost.

5.3 Responsibility

The MANPRINT data supporting the COEA-MANPRINT interface is developed by the combat developer with support from MANPRINT personnel and the training developer with the exception of human reliability data which is developed by the RAM analyst. The combat developer shall coordinate integration of the human reliability data with other MANPRINT data. There should be close coordination with the AMC cost analysis.

5.4 When

MANPRINT data is needed prior to the implementation of the initial Type I COEA or Abbreviated Analysis. It may be presented as bands of information initially. MANPRINT data is updated as necessary to meet COEA update requirements or a more refined set of data (i.e., more point estimates) is required for Type II COEAs.

5.5 Analytical Techniques

There are a number of analytical techniques that may be employed to develop the data required for each MANPRINT domain. Table 5-1 indicates which analytical technique may be applied to develop the data from each domain. The COEA-MANPRINT toolkit contained in Appendix F contains procedures for selecting and implementing the appropriate procedure.

Table 5-1. MANPRINT Analytical Techniques

ANALYTICAL TECHNIQUE	MANPRINT DOMAIN					
	M	P	T	HFE	SS	HHA
1. MPT Estimation Techniques	X	X	X			
2. Early Comparability Analysis	X	X	X	X	X	X
3. LSA Task 201 - Use Study	X		X		X	X
4. HARDMAN	X	X	X			
5. MARC	X					
6. RAM Manpower Estimate	X					
7. Human Reliability Simulation		X				
8. Task Performance Modeling		X				
9. Operator/Crew Workload Analysis		X				
10. MIST Validation			X			
11. TEA			X			
12. HFE Assessment				X		
13. Safety Assessment					X	
14. Health Hazards Assessment						X

5.6 Integration

There are key MANPRINT domain relationships. MPT data may be significantly affected by the results of the HFE, SS, and HH analyses because of the identification of problems which impact quantitative and qualitative personnel requirements or the identification of design, maintenance, or operating options for which MPT should be estimated and included in the COEA.

Most importantly, the quantitative and qualitative personnel requirements are driven by the human reliability requirements. In turn, human

reliability may be improved or achieved not only through personnel upgrades (which implies skill creep), but also by enhancements in training, HFE, system design and function allocation, maintenance philosophy, system safety, etc. Therefore, it is imperative that the total MANPRINT picture be assessed and alternatives/tradeoffs be considered when evaluating the system cost and operational effectiveness.

5.7 Checklist Questions

- Are MPT data presented in quantitative terms?
- Are all assumptions clearly stated for any MPT options identified?
- Is human reliability and the impact personnel performance on operational effectiveness stated for both operating and maintenance personnel?
- Is human performance affected by cognitive workload?
- How will system performance be affected by changes in manning levels?
- Is there any aspect of the equipment, its use, or its maintenance that could degrade soldier performance?
- Is there evidence that training could reduce workload?

5.8 Traps

- MANPRINT data could be based on specifications different from those being used for COEA, RAM, etc. For instance, different OMS/MP requirements are used, or different predecessor or reference systems are used.
- Complex analytical techniques are selected (e.g., HARDMAN) when the process does not warrant the depth of analysis or existing data will not support the analytical technique early on in the materiel acquisition process.
- Failure to adequately consider HFE, SS, and HH data when developing MPT estimates and options.

- Presenting MPT options without clearly stating underlying assumptions or accompanying conditions.

- Overlooking a critical impact on force structure or operational effectiveness that an MPT estimate may have.

5.9 References

- AR 40-10 Health Hazards Assessments

- AR 385-16 System Safety Engineering Program

- AR 602-1 Human Factors Engineering Program

- _____ Early Comparability Analysis Handbook

- _____ HARDMAN Comparability Analysis Methodology Guide

6.0 ROC-MANPRINT INTERFACE

6.1 Overview

A ROC is a formal requirement that when approved commits the Army to program development or acquisition. It will not normally be approved until proof of principle has been conducted under an approved O&O Plan. It is prepared by the combat developer, in coordination with the HQDA, materiel developer, training developer, RSI manager, logistician, test & evaluator, interested MACOM, and the designated MANPRINT representative. The approved ROC is required as a basis for decision to start full scale development/proveout or acquisition of a materiel system.

A full MANPRINT Assessment is included in the ROC. The MANPRINT Assessment will cover each of the MANPRINT domains as follows:

Manpower/force structure assessments. Estimate manpower requirements per system, per unit, and total Army (Active, ARNG, USAR). Include an assessment of alternatives to reduce manpower requirements by component. If increases in force structure are required, then a trade-off analysis must be conducted.

Personnel assessment. Identify personnel constraints by operator, maintainer, repairer, and other support MOS. Describe the aptitude of the intended operator, maintainer, and repairer. An analysis must be conducted to assess any changes to the MOS structure of MOS workload. A summary of the relationship of soldier performance to measures of system effectiveness should be included.

Training Assessment. Discuss overall training strategy to include the need for system training devices (TD) and embedded training requirements. New equipment training (NET), operator, maintenance personnel training, technical manuals (TM), and training materiel requirements will be stated in terms of need for both institutional and unit training.

Human Factors Engineering (HFE). Identify the need for a HFE analysis and address the HFE considerations and constraints.

System safety. Address system safety requirements and safety considerations and constraints.

Health hazard assessment. Address health hazard requirements and health hazard considerations and constraints.

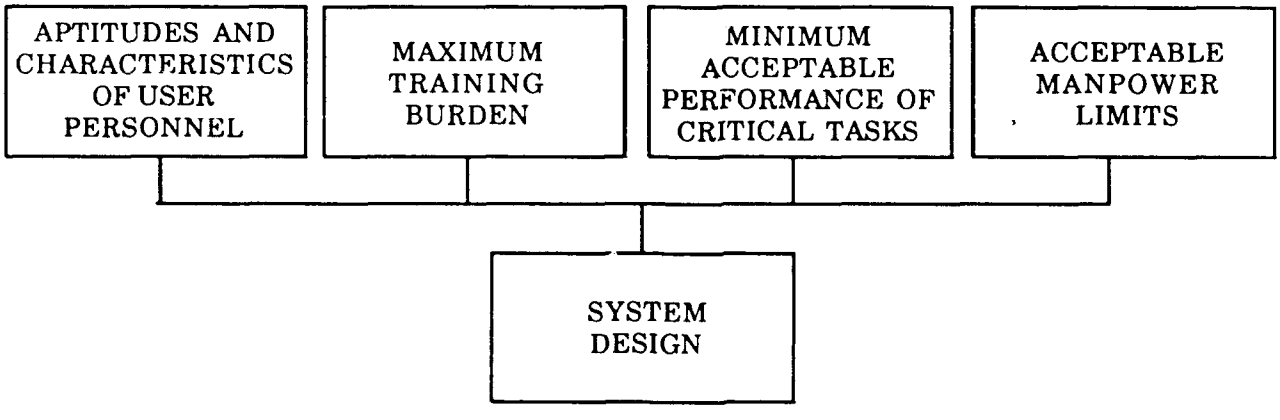
The results of the MANPRINT assessments are analyzed to determine how they impact on the following four essential sets of MANPRINT requirements and constraints:

- o Aptitudes and Characteristics of User Personnel
- o Maximum Training Burden
- o Minimum Acceptable Performance of Critical Tasks
- o Acceptable Manpower Limits

Each of these four MANPRINT essentials should be addressed in paragraph 8 of the ROC along with other MANPRINT requirements, constraints, or limitations.

As stated earlier, MANPRINT data in the ROC influences design decisions. These decisions may include equipment design, maintenance philosophy, or development. Figure 6-1 illustrates the manner in which MANPRINT data in the ROC influences system design.

Figure 6-1. MANPRINT Requirements Affecting Optimum System Design (From AMC-P 602-1)



6.2 Data Requirements

Essentially, providing data for the ROC-MANPRINT interface does not require employing new analytical techniques and generating new data, but rather re-evaluating the MANPRINT data generated for the O&O Plan, COEA, and RAM interfaces and ensuring that MANPRINT data, including objectives, concerns, and unresolved questions, has been fully integrated. In addition, recommendations regarding MANPRINT factors and their impact on materiel characteristics such as equipment design, maintenance philosophy, or deployment should be clearly spelled out.

The following subsections identify the specific data required for each MANPRINT domain:

6.2.1 Manpower Data Requirements

Quantitative manpower requirements (i.e., numbers of personnel by MOS) should be presented by system, unit, and total Army (Active, ARNG, USAR). This data was developed as input to the COEA. It should be presented for all materiel solution alternatives, and any MPT alternatives that were assessed as part of the RAM- or COEA-MANPRINT interfaces (manpower data also will be included as part of the TQQPRI which will be submitted with the BOIP at the time the materiel requirements document (i.e., ROC, Letter Requirement, etc.) is prepared). Manpower objectives, concerns, and/or unresolved questions identified in the MANPRINT Annex to the O&O Plan should be addressed. These should be statements as to whether the proposed manpower will meet objectives and discussions of any remaining manpower constraints, concerns, or unresolved questions.

6.2.2 Personnel Data Requirements

In conjunction with the quantitative manpower requirements submitted, qualitative personnel requirements will be refined and included as part of the total manpower/personnel summary. Additionally, a Target Audience Description (Target Audience Description) will be prepared. This will require enhancing the qualitative personnel profile considerably in terms of skill, education, and testing criteria (qualitative personnel data will be presented in the TQQPRI).

Any qualitative personnel alternatives evaluated as part of the COEA

schedule should be presented. In addition, the human reliability data and its relationships to measures of system effectiveness (i.e., MTBOMF, MTBUMA, MTTR, and ALDT) should be presented and discussed.

Personnel objectives, constraints, concerns, and/or unresolved questions identified in the MANPRINT Annex to the O&O Plan should be addressed or described in the previous subsection.

6.2.3 Training Data Requirements

Training data that was developed as an input to the COEA data, including hours of training (both institutional and unit) by MOS, need for training devices, and embedded training will be re-evaluated and summarized. A discussion of the proposed training strategy and alternative training concepts based on personnel options addressed in the COEA will be included.

There is a requirement for new training data at this time. It includes the description of the need for training material and technical manuals in terms of both institutional and unit training.

Training objectives, constraints, concerns, and/or unresolved questions identified in the MANPRINT Annex to the O&O Plan should be re-evaluated in light of the MANPRINT analyses that have been conducted since submittal of the O&O Plan. Each should be revised to reflect the current state of knowledge regarding MANPRINT factors and materiel design.

6.2.4 HFE Data Requirements

Requirements for HFE assessment should be stated along with the related concern or unresolved question. It is important that the ROC contain a summary of any preliminary HFE assessment (e.g., comparative analysis), a statement of related concerns or unresolved issues, and a precise specification of the HFE assessment and evaluation techniques that are required in order to ensure that the man-machine interfaces are optimized.

6.2.5 SS Data Requirements

Results of the Preliminary SS Analysis should be reported. SS objectives, constraints, concerns, and/or unresolved questions identified in the MANPRINT Annex to the O&O Plan should be addressed as described in Section 6.2.1. Future SS analyses requirements should be stated as they relate to SS concerns and unresolved questions.

6.2.6 HH Data Requirements

Results of the Preliminary HH Analysis should be reported. HH objectives, constraints, concerns, and/or unresolved questions identified in the MANPRINT Annex to the O&O Plan should be addressed as described in Section 6.2.1. Future HH analyses requirements should be stated as they related to HH concerns and unresolved questions.

6.3 Responsibility

It is the responsibility of the combat developer to coordinate MANPRINT inputs to the ROC. The Combat developer will be assisted by the training developer, MANPRINT planner, materiel developer, and other MANPRINT points of contact as required. The materiel developer is responsible for providing BOIP feeder data and QQPRI to the combat developer.

6.4 When

MANPRINT data should be prepared and submitted in accordance with the ROC schedule for development and review.

6.5 Analytical Techniques

Since the ROC-MANPRINT interface is primarily concerned with the re-evaluation and integration of MANPRINT data, no special analytical techniques are required. The ROC-MANPRINT Toolkit contained in Appendix G provides a more detailed format, and procedures for compiling and reporting data.

6.6 Integration

The constraints, concerns, and/or unresolved questions from any MANPRINT domain must be assessed in terms of potential impact on other MANPRINT domains, system considerations, and mission effectiveness to ensure consistency within MANPRINT requirements. It is critical that MPT data that is generated for BOIP and TQQPRI activities is consistent with other MPT data. The combat developer is Responsible for ensuring that MPT data generated during RAM and COEA related analyses is the basis for MPT estimates and requirements in both the ROC and other materiel acquisition process MPT related activities including LSA, TQQPRI, and BOIP.

6.7 Checklist Questions

- Are MANPRINT data found in different requirements documents (i.e., ROC, BOIP, QQPRI, and Target Audience Description) consistent?

- Is each MPT alternative identified and discussed?

- Is the relationship between human reliability and measures of system effectiveness clearly stated?

- Are further analysis requirements stated?

- Are any impacts on force structure identified and discussed?

6.8 Traps

- Not considering the implications of MANPRINT from an integrated perspective. For example, a concern regarding a human engineering problem may focus on the impact of the problem, or its resolution, on mission effectiveness but not consider the implications on force structure, training, or even technology feasibility.

- Having inconsistencies in the MANPRINT data found in different documents.

- Not defining all assumptions and conditions that are associated with each of the MANPRINT requirements and/or concerns.

6.9 References

- AR 71-9 Materiel Objectives and Requirements
- MANPRINT Primer
- System MANPRINT Management Plan (SMMP) Procedural Guide

7.0 RFP-MANPRINT INTERFACE

7.1 Overview

The principal means by which the Army finally communicates its materiel requirements to industry is the Request for Proposal (RFP). The process of preparing the RFP essentially consists of converting the requirements document (e.g., a ROC prepared by TRADOC) and its supporting documentation (e.g., O&O Plan, COEA, etc.) into the RFP and an accompanying System Specification. MANPRINT concerns are not isolated into a separate part of the RFP but fully integrated with the technical RFP preparation and are addressed in at least the following six places in the RFP:

- **The Executive Summary** transmits to senior industry personnel the major importance and emphasis the Army attaches to MANPRINT. This is most effectively accomplished by summarizing the impact MANPRINT issues will have in the source selection process.

- **The Statement of Work (SOW)** states what the Army wants the contractor to do (i.e., task statements) in developing the system. It describes both the deliverables to be provided under contract and the work to be done to assure that the developed system performs as specified.

- **The System Specification** describes how the system is supposed to look and act and how these specified looks and actions are to be verified.

- **The Contract Data Requirements List (CDRL)** explains to an offeror what information (often typed reports) the contractor will be required to furnish to the government about the tasks being accomplished and the performance of the hardware and software being developed, how often, and in what form. The process for preparing a CDRL is complex and highly structured. In general, once the needed MANPRINT data are identified, the specific data requirements and schedule of delivery are spelled out in the RFP using DD Form 1423, "Contract Data Requirements List (CDRL)." Each item is keyed to a tasking in the SOW ar to a specification

requirement. The data must be described in terms of standardized Data Item Descriptions (DIDs) which are themselves catalogued in the Acquisition Management Systems and Data Requirements Control List (AMSDL)

- **Instructions to Offerors** contains many helpful hints to an offeror trying to write a responsive proposal. These instructions often include coordination statements (e.g., that the MANPRINT and ILS programs should not be conducted in a duplicative fashion), and instructions on what specific matters must be covered in detail in the technical proposal. It describes both the deliverables to be provided under the contract and the work to be done to assure that the developed system performs as specified.

- **Proposal Evaluation Criteria** explain to an offeror how his technical proposal will be evaluated by the Source Selection Evaluation Board (SSEB). Both technical criteria and relative importance are shown.

7.2 Data Requirements

AMC-P 602-1 describes in detail and presents examples of the MANPRINT inputs to the RFP.

7.3 Responsibility

Development of the RFP is led by the Army materiel developer with the support and assistance of the combat developer and specialists from other agencies. From the MANPRINT viewpoint, it is important that the draft RFP be coordinated with the System MANPRINT Manager, if one has been designated; the MJWG, the TRADOC System Manager, and the ILS Manager. In the absence of a System MANPRINT Manager, coordination should be made with the System ILS Manager (Note: within AMC the ILS Manager is usually designated the MANPRINT Manager). In the absence of a MJWG, coordination should be made with appropriate agencies selected from among hose listed below.

7.4 When

As stated in Section 7.1, MANPRINT is fully integrated into RFP process, and the conversion of MANPRINT requirements into contractual requirements and design constraints set forth in the RFP occurs simultaneously with the conversion of hardware/software requirements.

7.5 Analytical Techniques

Guidelines for preparing MANPRINT aspects of the RFP are contained in AMC-P 602-1, MANPRINT HANDBOOK FOR RFP DEVELOPMENT. These guidelines are supplemented by the RFP-MANPRINT Toolkit contained in Appendix H of this document. The RFP-MANPRINT Toolkit specifically focuses on how to establish soldier performance standards within the overall context of system performance requirements.

7.6 Integration

RFP-MANPRINT integration as (1) integration of the activities and data from the six MANPRINT domains and (2) integration of the domain data with system design, maintenance, logistics, and support are addressed in AMC-P 602-1.

7.7 Checklist Questions

- Are all MANPRINT essentials converted to RFP requirements and included in system specifications?
- Are MPT requirements and constraints stated in precise quantitative terms?
- Are there CDRL items and DIDs associated with each tasking in the SOW?
- Are coordination requirements defined and spelled out in the technical proposal and the Instructions to the Offers.

7.8 Traps

- o One or MANPRINT essentials are missing or incomplete. If any one of the four parts is missing, the system designer (contractor) is offered an escape from the design specifications.

- o "Boilerplate" is used instead of customizing the requirements of the specific system.

- o Assumption is made that the contractor will do it the way you want it, even though it is not precisely spelled out in the RFP.

7.9 References

- o AMC-P 602-1 MANPRINT Handbook for RFP Development

8.0 T&E-MANPRINT INTERFACE

8.1 Overview

The T&E-MANPRINT Interface primarily focuses on verifying that the system meets MANPRINT requirements and achieves its operational effectiveness objectives. The T&E-MANPRINT Interface objectives are to:

- o Identify MANPRINT test issues and establish clear MANPRINT T&E objectives for each test issue
- o Establish standards, measures, and criteria for each personnel performance (e.g., HR-FD/SC) or system MANPRINT-related test issue.
- o Integrate fully MANPRINT domain T&E issues
- o Integrate fully MANPRINT and system T&E issues

MANPRINT T&E actually begins with the steps of developing the HR-FD/SC and identifying initial MANPRINT test issues, concerns, and unresolved questions in the MANPRINT annex to the O&O Plan. Formally, however, the MANPRINT T&E program develops concurrently, and is integrated, with the materiel T&E program. The initial materiel acquisition activities focussing specifically on T&E are the establishment of the Coordinated Test Program (as part of Logistics Support Planning) and the development of the Test and Evaluation Master Plan (TEMP).

MANPRINT standards, measures, test issues, criteria, and test plan and procedures are provided to the test and evaluation community through the TEMP. MANPRINT also plays an active part in DT/OT and operation effectiveness evaluations of field systems.

8.2 Data Requirements

MANPRINT test and evaluation will be fully integrated with system T&E, and MANPRINT T&E requirements will be either included as a part of the system T&E documentation or have specific MANPRINT T&E documentation developed. The first step in the formal T&E program is developing the Coordinated Test Program (CTP). The CTP is a

management program for identifying required testing, test personnel and organizations, materiel, facilities, logistic support, troop support, and funds for implementing test programs. It will identify the critical issues to be explained through testing and he planned testing to resolve those issues. It is used to plan, coordinate, and integrate the scheduling of tests. Based on the CTP requirements, the TEMP is developed. The TEMP is a broad plan that relates test objectives to required system characteristics and critical issues and integrates objectives, responsibilities, resources, and schedules for all T&E to be accomplished.

MANPRINT test requirements shall be fully incorporated into the TEMP and integrated into system test planning. For other required test plans, there should be separate but fully integrated MANPRINT versions. That is, there should be, as required for the system hardware/software, MANPRINT versions of the following:

- o Independent Evaluation Plan (IEP)
- o Outline Test Plan (OTP)
- o Test Design Plan (TDP)
- o Detailed Test Plan (DTP)

These MANPRINT test documents are prepared separately for DT and OT. In addition to DT/OT reflected activities, there is an interface between MANPRINT and Follow-on Operational T&E (FOT&E).

8.3 Responsibility

The materiel developer is responsible for programming, coordinating, distributing, and maintaining the CTP, IEP, OTP, TDP, and DTP for DT and OT. The materiel developer will be supported by the MANPRINT analyst and the operational tests.

8.4 When

CTP, IEP, OTP, TDP, and DTP will be prepared and updated during the acquisition phases prior to the scheduled tests and finalized for the milestone decision reviews.

8.5 Analytical Techniques

The T&E-MANPRINT Toolkit contained in Appendix I provides guidelines for the development and implementation of MANPRINT CTP, IEP, OTP, TDP, and DTP documentation.

8.6 Integration

The MANPRINT test documentation should be closely coordinated with materiel test documentation to ensure efficient yet comprehensive resolution of all test issues and unresolved questions. Coordination and integration of MANPRINT and materiel T&E analyses with the CTP, and the MANPRINT analyst should be a full participant in the CTP presentation.

In the event (i.e., for all majors and DAPs) a Test Integration Working Group (TIWG) is chartered, MANPRINT representatives should be part of the group.

8.7 Checklist Questions

- Are all test issues, constraints, and unresolved question contained in the O&O Plan, SMMP, and ROC reflected in the test documentation?
- Are HR-FD/SC presented in test documentation?
- Does the CTP provide for all required test support?
- Do testing groups reflect target audience descriptions?
- Are MANPRINT and materiel test documents consistent?
- Has the MANPRINT analyst reviewed all test documentation?

8.8 Traps

- Failure to clearly state all assumptions and conditions underlying tests.

- Failure to state test variables and to establish standards of performance and acceptance criteria.

- Using unqualified test evaluators.

- Not collecting all the data required to make reasonable assessments of he impact of human performance and reliability on system operational effectiveness.

8.9 References

- AR 70-1 Army Research, Development and Acquisition

- AR 70-10 Test and Evaluation During Development and Acquisition of Materiel

- AR 71-3 User Testing

- DA Pam 70-21 The Coordinated Test Program

9.0 FIELDING-MANPRINT INTERFACE

9.1 Overview

Fielding includes shipping, deprocessing, deploying, and sustaining materiel being fielded within a command[1]. Fielding a system incorporates several specific materiel acquisition process activities for which there are important MANPRINT interfaces. However, the key to the Fielding-MANPRINT interface is ensuring that the MANPRINT data and requirements are well integrated into the Materiel Fielding Plan (MFP). The MFP contains plans, schedules, procedures, and materiel fielder (DARCOM) gaining major Army command (MACOM) actions necessary to successfully ship, deprocess, deploy, and sustain materiel being fielded for the first time within a gaining command.

9.2 Data Requirements

The MFP should contain data from the MANPRINT domains of manpower, personnel, and training--as described in the following subsections.

9.2.1 Manpower and Personnel Requirements

The MFP should include final MOS data including quantitative and qualitative requirements. MOS, skill level, AFQT data, and other QQPRI data should be included. It is important that this data reflect any modifications to manpower and personnel requirements resulting from the T&E program. Manpower and personnel data should include manning schedule for the first unit equipped as well as for complete deployment to each major command (to include the Army Reserves, National Guard, the other services and Defense Agencies).

9.2.2 Training Data Requirements

New Equipment Training (NET) provides for the knowledge and skills that are needed for operation, maintenance, and logistic support during testing and initial introduction of new materiel into the Army inventory. NET

[1] By design, this MANPRINT Analysis Methodology stops at the Fielding- MANPRINT Interface and does not address Poat-Fielding concerns such as operational evaluation of system effectiveness. Post-Fieding analysis and evaluation will be addressed in future MANPRINT guideline.

requirements are established in a New Equipment Training Plan (NETP), which is included in the Program Development Plan. The NETP covers the Individual and Collective Training Plan, the NET Test Support Package, and overall training planning and logistics. The MFP should include a summary of NETP requirements to ensure coordination of training with deployment.

9.3 Responsibility

The materiel developer is responsible for preparing the MFP. The materiel developer will be responsible for establishing a materiel fielding team and a New Equipment Training Team (NETT) as required to support fielding activities.

9.4 When

MANPRINT manpower, personnel, and training requirements and data should be included in the draft MFP and updated concurrently with updates of the MFP.

9.5 Analytical Techniques

No new analytical techniques are required in support of the Fielding-MANPRINT interface. The Fielding-MANPRINT Toolkit contained in Appendix J describes in detail and provides guidelines for the process of integrating MANPRINT into the Fielding activities.

9.6 Integration

Development of the Fielding MPT requirements should be integrated with the T&E program to ensure that no MPT requirements need to be modified. For major items the key vehicle for integrating MFP and training is the New Equipment Training Team established by the materiel developer.

It is crucial that training and SPA requirements be coordinated and that appropriate tradeoff studies are conducted.

9.7 Checklist Questions

- Are the requirements for training personnel adequately defined?

- Was there an adequate analysis of he costs and benefits of potential instructional strategies?

- Will training equipment be developed in time to support training for deployment?

- Will there be a cadre of trained personnel on-hand to perform initial training?

- Was there a reasonable tradeoff between embedded test and diagnostic procedures and manpower and personnel skill levels?

- Are projected manpower and personnel adequately defined?

- Was support equipment tested to identify known factor deficiencies?

- Are, or have, MANPRINT concerns and unresolved questions satisfactorily resolved?

9.8 Traps

- Including MPT data without reevaluating requirements on the basis of T&E results.

- Not establishing fielding requirements, with long lead times, early enough in the cycle.

- Not adequately accounting for the New Equipment Training support.

- Not coordinating Skill Performance Aids (SPAS) development with NET.

9.9 References

- AR 700-120 Materiel Distribution Management for Major Items
- AR 350-35 New Equipment Training and Introduction
- DARCOM-R 700-15 Integrated Logistics Support

APPENDIX A

LIST OF ACRONYMS

AA	Abbreviated Analysis
AAMMH	Annual Available Maintenance Man Hours
AFQT	Armed Forces Qualification Test
AIT	Advanced Individual Training
ALDT	Administrative and Logistics Downtime
AMC	U.S. Army Materiel Command
AMMH	Annual Maintenance Man Hours
AMSDL	Acquisition Management Systems and Data Requirements Control List
ARI	Army Research Institute
ARNG	Army National Guard
ARTEP	
ASARC/JRMB	Army Systems Acquisition Review Council/Joint Requirements and Management Board
ASI	Additional Skill Identifier
BCS	Baseline Comparison System
BOIP	Basis of Issue Plan
CDRL	Contract Data Requirements List
COEA	Cost and Operational Effectiveness Analysis
CTEA	Cost and Training Effectiveness Analysis
CTP	Coordinated Test Plan
DAP	Designated Acquisition Program
DARCOM	US Army Materiel Development and Readiness Command
DIDs	Data Item Descriptions
DOD	Department of Defense
DPAMMH	Direct Productive Annual Maintenance Man Hours
DPT	Detailed Test Plan
DT	Development Testing
ECA	Early Comparability Analysis
FAT	First Article Test
FD/SC	Failure Definition/Scoring Criteria
FLOT	Forward Line of Troops

FOT&E	Follow-On Operational T&E
FUE	First Unit Equipped
HARDMAN	Hardware versus Manpower Comparability Analysis
HFE	Human Factors Engineering
HFEA	Human Factors Engineering Assessment
HH	Health Hazard
HHA	Health Hazard Assessment
HQDA	Headquarters, Department of the Army
HR	Human Reliability
ICTP	Individual and Collective Training Program
IEP	Independent Evaluation Plan
ILS	Integrated Logistic Support
JMSNS	Justification for Major System New Start
JSOR	
LSA	Logistics Support Analysis
MACOM	Major Army Command
MAP	Materiel Acquisition Process
MARC	Manpower Authorization Requirements Criteria
MEF	Mission Essential Function
MDR	Milestone Decision Review
MFP	Materiel Fielding Plan
MJWG	MANPRINT Joint Working Group
MOS	Military Occupational Specialty
MPT	Manpower, Personnel, Training
MTBF	Mean Time Between Failure
MTBOMF	Mean Time Between Operational Mission Failure
MTBUMA	Mean Time Between Unscheduled Maintenance Actions
MTOE	Modification Table of Organization and Equipment
MTTR	Mean Time to Repair
NET	New Equipment Training
NETP	New Equipment Training Plan
NETT	New Equipment Training Team

O&O Plan	Operational & Organizational Plan
OMS/MP	Operational Mode Summary/Mission Profile
OT	Operational Testing
OTP	Outline Test Plan
PHA	Preliminary Hazard Analysis
QQPRI	Qualitative and Quantitative Personnel Requirements Information
RAM	Reliability, Availability, Maintainability
RFP	Request for Proposal
ROC	Required Operational Capability
RSI	Rationalization, Standardization, and Interoperability
SDC	Sample Data Collection
SMMP	System MANPRINT Management Plan
SOW	Statement of Work
SPA	Skilled Performance Aid
SS	System Safety
SSEB	Source Selection Evaluation Board
STEHR	Simplified Techniques for Estimating Human Reliability
T&E	Test & Evaluation
TAD	Target Audience Description
TD	Training Device
TDP	Test Design Plan
TEMP	T&E Master Plan
TIWG	Test Integration Working Group
TM	Technical Manuals
TMDE	Test Measurements and Diagnostic Equipment
TOE	Table of Organization and Equipment
TSP	Test Support Package
TQQPRI	Tentative Qualitative and Quantitative Personnel Requirements Information
TRADOC	US Army Training and Doctrine Command
USAR	US Army Reserve

APPENDIX B

GLOSSARY OF TERMS

Additional Skills Identifier (ASI). Consists of a letter and a number may be added to the basic five character MOS code to identify certain highly specialized skills that are in addition to the skills required by the MOS.

Anthropometric. Of or relating to the study of human body measurements, especially on a comparative basis.

Armed Forces Qualification Test (AFQT). The AFQT is a combination of Verbal, Arithmetic Reasoning, and Numerical Operations ASVAB subtests. The AFQT is used to screen out applicants whose mental characteristics are not sufficient for Army duties. AFQT composite is a good general intelligence test as well as a practical index of reading ability.

Availability (Operational). A measure of the degree to which a system is either operating or is capable of operating at any time when used in its typical operational and support environment.

Basis of Issue Plan (BOIP). A planning document that lists specific levels at which a new item of materiel may be placed in a unit/organization; the quantity of the item proposed for each organization element; and other equipment and personnel changes required as a result of the introduction of the new item. The BOIP is not an authorization document.

Biomedical. Of or relating to a branch of medical science concerned especially with the capability of human beings to survive and function in abnormally stressing environments and with the protective modification of such environments.

Cost and Training Effectiveness Analysis (CTEA). A methodology which involves documented investigation of the comparative effectiveness and costs of alternative training systems for attaining defined performance objectives, taking into consideration usage pattern and training scenarios. A CTEA can examine training concepts, training equipment, training strategies, programs of instruction, training implications of new materiel, organization, tactics, employment techniques, or families of systems. CTEA is used in conjunction with the COEA.

Development Testing (DT). Testing of materiel systems conducted by the materiel developer using the principle of a single, integrated development

test cycle to demonstrate that the design risks have been minimized, that the engineering development process is complete, and that the system will meet specifications; and to estimate the system's military utility when it is introduced. DT is conducted in factory, laboratory, and proving ground environments.

Embedded Training. Training that is delivered by an equipment system in addition to the primary operational function. The training is made available by components of the equipment that take advantage of the overall system capabilities.

First Article Test (FAT). Production testing that is planned, conducted, and monitored by the materiel developer. FAT includes pre-production and initial production testing conducted to insure that the contractor can furnish a product that meets the established technical criteria.

First Unit Equipped (FUE). The first troop unit to be equipped with the first production items/systems.

First Unit Equipped Date. The schedule date a system or end item and its agreed upon supporter elements are issued to the designated initial operational capability unit and training specified in the new equipment training plan has been accomplished.

Follow-On Operational T&E (FOT&E). Test and evaluation conducted subsequent to a Milestone III production decision to obtain information lacking from earlier initial operational test and evaluation. Normally, FOT&E is conducted subsequent to the decision to proceed beyond low rate initial production.

Health Hazard (HH). An existing or likely condition, inherent to the operation or use of materiel, that can cause death, injury, acute or chronic illness, disability, and/or reduced job performance of personnel by exposure to:

- Shock/Recoil
- Vibration
- Noise (including steady state, impulse, and blast overpressure)
- Humidity
- Toxic Gases

- o Toxic Chemicals
- o Ionizing or non-ionizing radiation (including X-rays, gamma rays, magnetic fields, microwaves, radio waves, and high intensity light).
- o Lasers
- o Heat and Cold
- o Oxygen deficiency
- o Blunt/sharp trauma
- o Pathogenic Microorganisms

Health Hazard Assessment (HHA). The application of biomedical and psychological knowledge and principles to identify, evaluate, and control the risks to the health and effectiveness of personnel who test, use, or service Army systems.

High Driver Task. A task identified, through analysis of task criteria, as costly in manpower, personnel, and training resources. The primary objective of ECA is to aid combat developers in identifying "high drivers" requiring a design change so that these tasks can be reduced in number or completely eliminated from new system design. Information from tasks derived from predecessor or reference systems are the key to determining the impact these tasks have on the Army MPT resources.

Human Factors Engineering Assessment (HFEA). HFEA deals with the comprehensive integration of soldier characteristics into Army doctrine and systems. It is used in system definition, design, development, and evaluation in order to optimize the capabilities and performance of human-machine combinations. It includes the principles and techniques of the science of human engineering, and covers all aspects of the soldier-machine interface.

Application of human factors engineering involves considerations of all relevant information pertaining to the following:

- o Human characteristics
- o Anthropometric data
- o System interface requirements
- o Human performance
- o Biomedical factors
- o Safety factors

In addition, human factors engineering analyses pertaining to the following are used as inputs to the consideration of Manpower, Personnel, and training issues in the MAP.

- o System manning levels
- o User, operator, and maintainer capability requirements

The adequacy of system HFE is evaluated during both development and operational testing.

Individual and Collective Training Plan (ICTP). The plan that identifies the training concept, strategy, and requirements for the system from initial qualification through sustainment and follow-on training for all MOS at all levels.

Job Analysis. The basic method used to obtain salient facts about a job, involving observation of workers, conversations with those who know the job, analysis questionnaires completed by job incumbents, and study of documents involved in performance of the job.

Learning Analysis. A procedure for identifying the support skills and knowledge of each stated objective that must be acquired before a soldier can demonstrated mastery of the objectives themselves.

Manpower. The personnel strength (military and civilian) as expressed in terms of the number of men and women available to the Army.

Considerations of the net effec of Army systems and items on overall Army human resource requirements and authorizations (spaces, to insure that each system is affordable from the standpoint of manpower). It includes analysis of the number of people needed to operate, maintain, and support each new system being considered or acquired, including maintenance and supply personnel and personnel to support and conduct training. It requires a determination of the Army manpower changes generated by the system, comparing the new manpower needs with those of the old system(s) being replaced, and an assessment of the changes on the total manpower limits of the Army. If, given manpower priorities established by the Department of the Army, systems cannot be supported by projected

manpower resources, then changes in system design, organization, or doctrine are made to achieve affordability. In the MAP, manpower analyses and actions are necessarily conducted in conjunction with force structure and budget processes.

Manpower Requirements Criteria (MARC). The number of direct workers required to effectively perform a specified work activity.

A principal computational component of MARC is the estimate of Annual Maintenance hours (AMMH) and its variations (AAMMH, and DPAMMH), each of which represent different contributing factors to the overall maintenance manpower and personnel determination. AAMMH, AMMH, and DPAMMH are MARC components of a system from the perspective of the factors each represents. These MARC components are defined below:

Annual Available Maintenance Man Hours (AAMMH). The number of annual man-hours each repairer is expected to be available under sustained operating conditions (e.g., wartime).

Annual Maintenance Man Hours (AMMH). The sum of the direct and indirect productive time required to repair an item.

Direct Productive Annual Maintenance Man Hours (DPAMMH). The estimated wrench-turning time required to repair a component or assembly.

$$\text{DPAMMH} = \frac{\text{Equipment Usage Rate}}{\text{Mean Time Between Repair}} \times \text{Mean Time to Repair}$$

Operational Testing (OT). Testing and evaluation of materiel systems accomplished with typical user operations. crews, or units in as realistic an operational environment as possible to provide data for estimating:

a. The military utility, operational effectiveness, and operational suitability (including compatibility, inoperability, reliability, availability, maintainability, supportability, operational man (soldier)-machine interface, and training requirements of new

systems.

b. From the user viewpoint, the system's desirability considering systems already available and the operational benefits and/or burdens associated with the new system.

c. The need for modification of the system.

d. The adequacy of the doctrine, organization, operating techniques, tactics, and training for employment of the system, and, when appropriate, its performance in a countermeasures environment.

Personnel. Military and civilian persons of the skill level and grades required to operate and support a system in peacetime and war.

Consideration of the ability of the Army to provide qualified people -- in terms of specific skills, experience, and other human characteristics -- needed to use, operate, maintain, and support Army systems or items. It requires detailed assessment of the aptitudes which soldiers must possess in order to complete training and use, operate and/or maintain the system successfully. Iterative analyses must be accomplished as integral components of the new system design process, comparing projected quantities of qualified personnel with the requirements of the new system, any system(s) being replaced, overall Army needs for similarly qualified people, and priorities established by the Department of the Army. As necessary, the system is configured specifically to accommodate the probable capabilities of personnel projected to be available, so that the new system is supportable from a personnel standpoint. Analysis of specific system personnel requirements using human factors engineering for each system design option considered, using "best available" information early in the acquisition process and improved information as the system design becomes firmer. Personnel analyses must consider not only simple availability, but also the capability of the Army personnel management system to provide the needed numbers of properly qualified people at a reasonable cost. Personnel must be included in the system life cycle cost estimates and system design tradeoffs -- machine costs versus personnel costs. Personnel analyses and projections are needed in time to allow orderly recruitment, training, and assignment of personnel in conjunction with equipment fielding.

Preliminary Hazard Analysis (PHA). As implied by the title, PHA is the initial effort in hazard analysis during the design phase or the programming and requirements development phase for facilities acquisition. It may also be used on an operational system for the initial examination of the state of safety. The purpose of the PHA is not to affect control of all risks, but to fully recognize the hazardous states with all of the accompanying system implications.

Preliminary Hazards List (PHL). The PHL provides to the materiel developer a list of hazards that may require special safety design emphasis or hazardous areas where in-depth analyses need to be done. The materiel developer may use the results of the PHL to determine the scope of follow-on hazard analyses.

Residual Hazards. Hazards that are not eliminated by design.

Safety Assessment Report. A formal summary of the safety data collected during the development and design of the system. In it, the materiel developer summarizes the hazard potential of the item, provides a risk assessment, and records procedures or other corrective actions to reduce these hazards to an acceptable level.

Sample Data Collection (SDC). A method for obtaining information on the performance and maintainability of an item of equipment. Data are obtained directly from observations made in the field. An effort is made to see that the sample from which the feedback is obtained is representative of the total population.

Soldier/Machine Interface. Consideration through system analysis and psychopysiology of equipment design and operational concepts to insure they are compatible with the capabilities and limitations of operators and maintenance personnel. Also referred to as soldier-materiel interaction.

System Safety (SS). The application of engineering and management principles, criteria, and techniques to optimize safety within the constraints of operational effectiveness, time, and cost throughout all phases of he system or facility life cycle.

System Safety Program. A description of the planned methods to be used by

the contractor to implement the tailored requirements of MIL-STD 8828, including organizational responsibilities, resources, methods of accomplishment, milestones, depth of effort, and integration with other program engineering and management activities and related systems.

Table of Organization and Equipment (TOE). The TOE is a table which prescribes the normal wartime mission, organizational structure, and personnel and equipment requirements for a military unit, and is the basis for an authorization document, the MTOE. The TOE is not an authorization document.

Target Population. The population defined for a training developments effort to insure the training products produced are compatible with the personnel in the field or to establish the parameters for the baseline (skills and knowledges) entry point for any officer or enlisted specialty training requirement.

Task Analysis. A process of reviewing actual job content and context to classify information into units of work within a job. The process provides a procedure for isolating each unique unit of work, provides a procedure for describing each unit accomplished, and provides descriptive information to assist in the design and testing of training products.

Test and Evaluation Master Plan (TEMP). A document used in the Army review and decision process to assess the adequacy of the planned testing and evaluation. It is prepared for all defense system acquisition programs. The TEMP is a broad plan that relates test objectives to required system characteristics and critical issues and integrates objectives, responsibilities, resources, and schedules for all T&E to be accomplished. Replaces Coordinated Test Plan (CTP).

Test Design Plan (TDP). A formal document developed by the test organization which states the circumstances under which a test and/or evaluation will be executed, the data required from the test, and the methodology for analyzing test results.

Test Integration Working Group (TIWG). A formally chartered organization chaired by the materiel developer and having as a minimum membership representatives (with authority to act for their respective

commands/activities) from the combat developer, the logistician, the operational tester, the materiel developer, and , when appropriate, the contractor. The primary purpose of the TIWG is to provide a forum for the direct communication to facilitate the integration of test requirements and speed up the TEMP coordination process. The objective of the TIWG is to reduce costs by integrating testing to the maximum extent, eliminate redundant testing, and facilitate coordination of test planning, interchange of data, and use of test resources to achieve cost-effective testing.

Test Support Package (TSP). Test support packages are provided by the proponent materiel developer and the combat developer/trainer. The proponent materiel developer provides packages consisting of the maintenance support for the item/system and a new equipment training package. The combat developer/trainer provides the following: statement of doctrine and techniques for employment, statement of organization and basis of issue and training plan. statement of logistic support concepts, mission profiles, statement of suitable threat for test and a description of test setting, including terrain and friendly forces situation.

Training. Consideration of the training necessary and the time required to impart the requisite knowledge, skills, and abilities to qualify Army personnel for use, operation, maintenance, and support of Army systems or items. It involves (1) the formulation and selection of engineering design alternatives, (2) the documentation of training strategies, and (3) the timely determination of resource requirements to enable Army training systems to support system fielding. Human factors engineering techniques are used to determine the tasks which must be performed by system user, operator, maintenance and support personnel, the conditions under which they must be performed, and the performance standards which must be met. Training is linked with personnel analyses and actions in that availability of qualified personnel is a direct function of the training process. As a minimum, the following must be considered:

- Training effort and cost versus system design
- Training times
- Training program development, considering aptitudes of available personnel
- Sustainment training, as distinguished from training associated with initial system fielding

- o Developmental training, as distinguished from Initial Entry Training
- o Training devices -- design, development, and use
- o Training base resourcing -- manpower and personnel implication
- o New Equipment Training (NET)
- o Formal training base instruction versus on-the-job training (OJT) in units
- o Unit training
- o Operational testing of the adequacy of training programs and techniques

Training Device (TD). Any three-dimensional object developed, fabricated, or procured specifically for improving the learning process. Training devices may be either system devices may be either system devices of non-system devices.

a. System devices are designed for use with one system of item of equipment, including subassemblies and components.

b. Non-system devices are designed to support general military training and/or for use with more than one system or item of equipment, including subassemblies and components.

APPENDIX C

DETAILED ILLUSTRATION OF MAP-MANPRINT INTERFACES

Table F-2. Basic Assumptions Underlying Manpower Analytical Techniques

Analytical Techniques	Basic Assumptions					
	Program Size	Predessor System	Analysis Expertise	Data Base	Scope of Applicability	Parallel Developments
MPT Estimation Technique						
ECA						
HARDMAN						
LSA Task 201						
MARC						
RAM Manpower Estimate						

Note: At this point we could develop a series of multiple choice questions that the user could ask himself about the system being acquired. He could then take his answers, and by using a very simple "look up" table, a specific analysis recommendation would be made.

3.0 DEVELOPING THE PERSONNEL ESTIMATE

3.1 Data Requirements

Personnel data required for the COEA include (1) a description of the aptitude requirements by MOS and Grade, (2) a statement of the impact of the manpower and personnel requirements on force structure, (3) estimates of human reliability for operation for each mission task identified in the MP and for maintenance personnel for each major subsystem, and (4) identification of any other system or mission characteristics that drive or constrain manpower and personnel requirements.

(1) Qualitative Personnel Requirements

Comprehensive qualitative personnel requirements are established and included in the Target Audience Description (TAD). However, initial COEA is most frequently required prior to the developments of the TAD. Further, the TAD contains considerably more qualitative personnel data than that required for the COEA. Table F-3 illustrates the critical data required for the COEA which includes the MOS, number of personnel required for each operations and maintenance jobs that was developed as the manpower estimate plus the distribution of manpower by AFQT category for the required aptitude area.

Table F-3. Base AFQT Distribution (Alternative 1)

			CATEGORY DISTRIBUTION (%)		
Job	MOS	No.	I-IIIA	IIIB	IV
Crew	11S				
Organizational Maintenance	45A				
	63A				
DS/GS Maintenance	31A				
	45Y				
	63B				

In the event, an alternative AFQT category distribution would be viable if mission, system, or environmental conditions were changed, the alternative AFQT distribution should be presented with a clear statement of the assumptions or conditions on which it was based.

(2) Impact on Force Structure

A statement of the impact of the quantitative and qualitative personnel requirements on force structure should be developed. The statement should, among other items, address availability of personnel types and consistency with force structure goals.

(3) Human Reliability Estimates

Section 4.0, RAM-MANPRINT Interface, covers the development of HR estimates and their use in establishing RAM requirements. The same HR estimates, or requirements as they actually are, will be inputs to the COEA. The HR data will be input in the same format and for the same measure of system effectiveness including:

- HR-MTBOMF
- HR-MTBUMA
- HR-MTTR
- HR-ALDT

Tables F-4 through F-6 contain the HR data that was developed through the RAM-MANPRINT analysis effort. As can be seen, each HR estimate is generated for alternative personnel configurations.

Table F-4. HR-MTBOMF Estimates for FLOT Defense Mission

Mission Task	Personnel Alternative		
	Alt. 1	Alt. 2	Alt. 3
1. Movement			
2. Set-up and Surveillance			
3. Search and Surveillance			
4. Target Acquisitions			
5. Track			
6. Fire (Air)			
7. Fire (Ground)			
8. Tear Down			

Table F-5. HR-MTBUMA Estimates for ABC System

	HR-MTBUMA		
	Personnel Alternative		
Subsystem	Alt. 1	Alt. 2	Alt. 3
TV Camera			
EO Pack			
AZ/EL Drive			
Tracker			
ECCM			
ACQ Sensor			
Missle/ Launcher			
Laser			
FLIR			
FC Elect			
Power Supply			
Carrier			

Table F-6. Maintenance HR Estimates for FLOT Defense Mission

	HR-MTTR			HR-MTBUMA		
	Personnel Alternative			Personnel Alternative		
Subsystem	Alt. 1	Alt. 2	Alt. 3	Alt. 1	Alt. 2	Alt. 3
TV Camera						
EO Pack						
AZ/EL Drive						
Tracker						
ECCM						
ACQ Sensor						
Missle/ Launcher						
Laser						
FLIR						
FC Elect						
Power Supply						
Carrier						

3.2 Selecting the Analytical Technique

Note: This section will parallel the corresponding sections for manpower and the other domains. A table identifying the analyses and basic assumptions will be contained. A set of questions and a "look-up" table will be used for obtaining specific recommendations for analytical techniques.

4.0 DEVELOPING THE TRAINING ESTIMATE

4.1 Data Requirements

Training information to be provided for the COEA includes the following:

- Number of training days of formal system specific operations and maintenance training for each MOS. It will include advanced individual training (AIT) and unit training estimates, but will not include any ARTEP, readiness experience activity, or field training exercises.

- Identification of special training devices or other training media requirements.

Table F-6 illustrates training data developed.

Table F-7. Training Requirements (in days)

			Training Requirements	
Job	MOS	No.	AIT	UNIT
Crew	11S			
Organizational Maintenance	45A			
	63A			
DS/GS Maintenance	31A			
	45Y			
	63B			

Training device requirements, including any requirements for embedded training, should be presented as per Table F-7. Data should be developed for each level of training (i.e., AIT, Unit Training, etc.)

Table F-8. Training Device Requirements for AIT

MOS	Training Device Requirements
11S	

4.2 Selecting the Analytical Technique

Note: Remainder of Appendix will be structured the same as the previous sections.

APPENDIX G

TOOLKIT: ROC-MANPRINT

APPENDIX H

TOOLKIT: RFP-MANPRINT

APPENDIX I

TOOLKIT: T&E-MANPRINT

APPENDIX J

TOOLKIT: Fielding-MANPRINT